

CLAIMS

1. A catalyst composition comprising at least two metal components selected from Groups 8 to 10 of the Periodic Table of Elements and at least one metal component selected from Group 13 of the Periodic Table of Elements.
2. The catalyst composition of claim 1 wherein one of said at least two metal components selected from Groups 8 to 10 of the Periodic Table of Elements is rhodium.
3. The catalyst composition of claim 2 wherein another of said at least two metal components is selected from iron, ruthenium and cobalt.
4. The catalyst composition of claim 1 wherein said at least one metal component selected from Group 13 of the Periodic Table of Elements is indium.
5. The catalyst composition of claim 1 and further including a binder and/or support.
6. A catalyst composition comprising:
 - (a) a first component comprising rhodium;
 - (b) a second component comprising at least one metal selected from Group 13 of the Periodic Table of Elements; and
 - (c) a third component comprising at least one metal different from said first and second components and selected from Groups 1 to 15 of the Periodic Table of Elements.
7. The catalyst composition of claim 6 and further including a support.
8. The catalyst composition of claim 7 and comprising from about 0.01 wt% to about 10 wt% of the first component, based on the rhodium metal present by weight of the total weight of the catalyst including the support.

9. The catalyst composition of claim 7 and comprising from about 0.04 wt% to about 5 wt% of the first component, based on the rhodium metal present by weight of the total weight of the catalyst including the support.
10. The catalyst composition of claim 7 and comprising from about 0.01 wt% to about 30 wt% of the second component, based on the amount of said Group 13 metal present by weight of the total weight of the catalyst including the support.
11. The catalyst composition of claim 7 and comprising from about 0.04 wt% to about 20 wt% of the second component, based on the amount of said Group 13 metal present by weight of the total weight of the catalyst including the support.
12. The catalyst composition of claim 7 wherein said second component comprises indium.
13. The catalyst composition of claim 12 and comprising from about 0.01 wt% to about 20 wt% of the second component, based on the amount of indium metal present by weight of the total weight of the catalyst including the support.
14. The catalyst composition of claim 11 and comprising from about 0.04 wt% to about 10 wt% of the second component, based on the amount of indium metal present by weight of the total weight of the catalyst including the support.
15. The catalyst composition of claim 7 and comprising from about 0.01 wt% to about 50 wt% of the third component, based on the amount of metal of said third component present by weight of the total weight of the catalyst including the support.

16. The catalyst composition of claim 7 and comprising from about 0.05 wt% to about 30 wt% of the third component, based on the amount of metal of said third component present by weight of the total weight of the catalyst including the support.

17. The catalyst composition of claim 6 wherein said third component comprises at least one metal selected from Groups 8 to 10 of the Periodic Table of Elements.

18. The catalyst composition of claim 6 wherein said third component is selected from iron, ruthenium and cobalt.

19. The catalyst composition of claim 7 wherein the third component is iron and the catalyst composition comprises from about 0.05 wt% to about 30 wt% of the third component, based on the amount of iron metal present by weight of the total weight of the catalyst including the support.

20. The catalyst composition of claim 7 wherein the third component is iron and the catalyst composition comprises from about 0.1 wt% to about 20 wt% of the third component, based on the amount of iron metal present by weight of the total weight of the catalyst including the support.

21. The catalyst composition of claim 7 wherein the third component is cobalt and the catalyst composition comprises from about 0.05 wt% to about 30 wt% of the third component, based on the amount of cobalt metal present by weight of the total weight of the catalyst including the support.

22. The catalyst composition of claim 7 wherein the third component is cobalt and the catalyst composition comprises from about 0.1 wt% to about 25 wt% of the third component, based on the amount of cobalt metal present by weight of the total weight of the catalyst including the support.

23. The catalyst composition of claim 7 wherein the third component is ruthenium and the catalyst composition comprises from about 0.05 wt% to about 10 wt% of the third component, based on the amount of ruthenium metal present by weight of the total weight of the catalyst including the support.

24. The catalyst composition of claim 7 wherein the third component is ruthenium and the catalyst composition comprises from about 0.1 wt% to about 5 wt% of the third component, based on the amount of ruthenium metal present by weight of the total weight of the catalyst including the support.

25. A catalyst composition comprising:

- (a) a first component comprising rhodium;
- (b) a second component comprising indium; and
- (c) a third component selected from one or more of iron, ruthenium and cobalt.

26. The catalyst composition of claim 25 and further including a support.

27. The catalyst composition of claim 26 and comprising from about 0.01 wt% to about 10 wt% of the first component, based on the rhodium metal present by weight of the total weight of the catalyst including the support.

28. The catalyst composition of claim 26 and comprising from about 0.04 wt% to about 5 wt% of the first component, based on the rhodium metal present by weight of the total weight of the catalyst including the support.

29. The catalyst composition of claim 26 and comprising from about 0.01 wt% to about 20 wt% of the second component, based on the indium metal present by weight of the total weight of the catalyst including the support.

30. The catalyst composition of claim 26 and comprising from about 0.04 wt% to about 10 wt% of the second component, based on the indium metal present by weight of the total weight of the catalyst including the support.

31. The catalyst composition of claim 26 wherein the third component is iron and the catalyst composition comprises from about 0.05 wt% to about 30 wt% of the third component, based on the amount of iron metal present by weight of the total weight of the catalyst including the support.

32. The catalyst composition of claim 26 wherein the third component is iron and the catalyst composition comprises from about 0.1 wt% to about 20 wt% of the third component, based on the amount of iron metal present by weight of the total weight of the catalyst including the support.

33. The catalyst composition of claim 26 wherein the third component is cobalt and the catalyst composition comprises from about 0.05 wt% to about 30 wt% of the third component, based on the amount of cobalt metal present by weight of the total weight of the catalyst including the support.

34. The catalyst composition of claim 26 wherein the third component is cobalt and the catalyst composition comprises from about 0.1 wt% to about 25 wt% of the third component, based on the amount of cobalt metal present by weight of the total weight of the catalyst including the support.

35. The catalyst composition of claim 26 wherein the third component is ruthenium and the catalyst composition comprises from about 0.05 wt% to about 10 wt% of the third component, based on the amount of ruthenium metal present by weight of the total weight of the catalyst including the support.

36. The catalyst composition of claim 26 wherein the third component is ruthenium and the catalyst composition comprises from about 0.1 wt% to about 5

wt% of the third component, based on the amount of ruthenium metal present by weight of the total weight of the catalyst including the support.

37. The catalyst composition of claim 25 wherein the molar ratio of rhodium to indium is from about 0.1 to about 1.2.

38. The catalyst composition of claim 25 wherein the molar ratio of rhodium to indium is from about 0.3 to about 0.9.

39. The catalyst composition of claim 25 wherein the molar ratio of rhodium to the metal of the third component is from about 0.001 to about 0.6.

40. The catalyst composition of claim 25 wherein the molar ratio of rhodium to the metal of the third component is from about 0.002 to about 0.3.

41. The catalyst composition of claim 26 wherein the support is selected from zirconia, alumina and ceria-alumina.

42. A method of making a catalyst composition, the method comprising:

- (a) applying a rhodium compound to a support;
- (b) applying a compound of a metal selected from Group 13 of the Periodic Table of Elements to the support; and
- (c) applying a compound of a further metal different from rhodium and from said Group 13 metal and selected from Groups 1 to 15 of the Periodic Table of Elements to the support.

43. The method of claim 42 wherein said further metal compound is applied to the support before either the rhodium compound or the Group 13 metal compound.

44. The method of claim 42 wherein the rhodium compound and the Group 13 metal compound are applied to the support concurrently.

45. The method of claim 42 wherein the Group 13 metal compound is applied to the support before the rhodium compound.
46. The method of claim 42 wherein the rhodium compound is rhodium nitrate.
47. The method of claim 42 wherein the Group 13 metal compound is an indium compound.
48. The method of claim 47 wherein the indium compound is indium nitrate or indium formate.
49. The method of claim 42 wherein the further metal compound is selected from iron, cobalt and ruthenium compounds.
50. The method of claim 42 wherein at least one of the compounds is applied to the support by impregnating the support with a solution of the compound.
51. The method of claim 42 wherein at least one of the compounds is applied to the support by precipitating the compound from a solution containing ions of the associated metal.
52. The method of claim 42 and, after (a) and/or (b) and/or (c), calcining the support at a temperature of about 100°C to about 600°C.
53. The method of claim 42 and, after (a), (b) and (c), treating the calcined support in a reducing atmosphere at a temperature in excess of 200°C.
54. A process for selectively removing alkynes or diolefins from a feedstock also containing olefins, the process comprising contacting the feedstock with hydrogen in the presence of a catalyst composition made by the method of claim 42.

55. A process for selectively removing alkynes or diolefins from a feedstock also containing olefins, the process comprising contacting the feedstock with hydrogen in the presence of a catalyst composition comprising at least two different metal components selected from Groups 8 to 10 of the Periodic Table of Elements and at least one metal component selected from Group 13 of the Periodic Table of Elements.

56. The process of claim 55 wherein the alkynes or diolefins have 2 to 4 carbon atoms and the feedstock also contains C₂ to C₄ olefins.

57. A process for selectively removing C₂ to C₄ alkynes or diolefins from a feedstock also containing C₂ to C₄ olefins, the process comprising contacting the feedstock with hydrogen in the presence of a catalyst composition comprising at least two different metal components selected from Groups 8 to 10 of the Periodic Table of Elements and at least one metal component selected from Group 13 of the Periodic Table of Elements, and the process producing an olefin-enriched product stream containing less than 20 weight % oligomerized alkyne and diolefin compounds, based on the weight of said oligomerized alkyne and diolefin compounds in said product stream by the weight of said feedstock.

58. The process of claim 57 and producing an olefin-enriched product stream containing less than 10 weight % oligomerized alkyne and diolefin compounds, based on the weight of said oligomerized alkyne and diolefin compounds in said product stream by the weight of said feedstock.

59. A process for selectively removing alkynes or diolefins from a feedstock also containing olefins, the process comprising contacting the feedstock with hydrogen in the presence of a catalyst composition comprising

- (a) a first component comprising rhodium;
- (b) a second component comprising indium; and
- (c) a third component selected from one or more of iron, ruthenium and cobalt.

60. The process of claim 59 wherein the alkynes or diolefins have 2 to 4 carbon atoms and the feedstock also contains C₂ to C₄ olefins.

61. The process of claim 59 wherein said contacting is conducted at a temperature of from about 20°C to about 150°C, a pressure of from about 690 kPa to 4100 kPa, and a molar ratio of hydrogen to alkynes and diolefins of from about 1 to about 1000.

62. The process of claim 59 wherein said contacting is conducted at a temperature of from about 30°C to about 100°C, a pressure of from about 1400 kPa to 3400 kPa, and a molar ratio of hydrogen to alkynes and diolefins of from about 1.1 to about 800.